

Application No. 09/604,097
Attorney's Docket No. 033022-004
Page 2

7
a first electrode electrically connected to the active layer via a first layer, the first layer having at least one layer including $\text{Al}_x\text{Ga}_{1-x}\text{N}$ where $0 \leq x < 1$; and

a second electrode electrically connected to the active layer via a second layer, the second layer having at least one layer including $\text{Al}_z\text{Ga}_{1-z}\text{N}$ where $0 < z \leq 1$ and $x < z$.

23. (New) The semiconductor light emitting device according to claim 22, where $2x \leq z$.

24. (New) The semiconductor light emitting device according to claim 22, wherein at least one of the first layer and the second layer includes In.

25. (New) The semiconductor light emitting device according to claim 22, wherein the InGa_N layer has a thickness not greater than 0.1 micrometers.

26. (New) The semiconductor light emitting device according to claim 22, wherein a band gap energy of each of the first layer and the second layer is greater than a band gap energy of the active layer, and the band gap energy of the first layer is less than a band gap energy of the second layer.

27. (New) The semiconductor light emitting device according to claim 26, wherein a difference between the band gap energy of the first layer and the band gap

Application No. 09/604,097
Attorney's Docket No. 033022-004
Page 3

energy of the active layer is not less than one third of a difference between the band gap energy of the second layer and the band gap energy of the active layer.

28. (New) The semiconductor light emitting device according to claim 22, wherein leakage of a positive hole from the active layer is prevented.

29. (New) The semiconductor light emitting device according to claim 22, wherein an operating voltage to inject an electron into the active layer of the device is lower than it would be if z were equal to x for the same x .

30. (New) The semiconductor light emitting device according to claim 22, wherein the first layer includes at least one non-doped n-type layer.

31. (New) A gallium nitride (GaN) type semiconductor light emitting device comprising:

an active layer including at least one InGaN layer, the InGaN layer having a thickness not greater than 0.1 micrometers;

an n-side electrode electrically connected to the active layer via an n-side layer, the n-side layer including at least one GaN layer that is one of doped and non-doped, and including at least one InGaN layer; and

Application No. 09/604,097
Attorney's Docket No. 033022-004
Page 4

a p-side electrode electrically connected to the active layer via a p-side layer, the p-side layer including at least one GaN layer and at least one of an AlGa_N layer and an InGa_N layer.

5-29-02
32. (New) The semiconductor light emitting device according to claim 31, wherein the active layer has a thickness of about 0.1 micrometers.

33. (New) The semiconductor light emitting device according to claim 31, wherein the p-side layer includes at least one GaN layer and at least one Al_zGa_{1-z}N layer where $0 < z \leq 0.15$.

34. (New) The semiconductor light emitting device according to claim 31, wherein a band gap energy of each of the n-side layer and the p-side layer is greater than a band gap energy of the active layer, and the band gap energy of the n-side layer is less than a band gap energy of the p-side layer.

35. (New) The semiconductor light emitting device according to claim 34, wherein a difference between the band gap energy of the n-side layer and a band gap energy of the active layer is not less than one third of a difference between the band gap energy of the p-side layer and the band gap energy of the active layer.

Application No. 09/604,097
Attorney's Docket No. 033022-004
Page 5

36. (New) The semiconductor light emitting device according to claim 31, wherein leakage of a positive hole from the active layer is prevented.

37. (New) The semiconductor light emitting device according to claim 31, wherein an operating voltage to inject an electron into the active layer is lower than it would be if, with the same n-side layer, the p-side layer contained substantially the same composition as that of the n-side layer.

38. (New) A GaN type semiconductor light emitting device comprising:
a light-emitting layer;
an n-side electrode electrically connected to the light-emitting layer through an n-type contact layer and an n-side layer, the n-side layer including Al and/or In; and
a p-side electrode electrically connected to the light-emitting layer through a p-type contact layer and a p-side layer, the p-side layer including Al and/or In,
wherein a band gap energy of the n-side layer is smaller than a band gap energy of the p-side layer.

39. (New) The device according to claim 38, wherein each of the band gap energy of the n-side layer and a band gap energy of the p-side layer is greater than a band gap energy of the light-emitting layer.

Application No. 09/604,097
Attorney's Docket No. 033022-004
Page 6

40. (New) The device according to claim 38, wherein a difference between the band gap energy of the n-side layer and a band gap energy of the active layer is not less than one third of a difference between a band gap energy of the p-side layer and the band gap energy of the active layer.

41. (New) The device according to claim 38, wherein the n-side layer includes In, the p-side layer includes Al, and the light-emitting layer includes at least one InGaN layer having a thickness not greater than 0.1 micrometers.

42. (New) The device according to claim 38, wherein the device has a double hetero structure, the n-side layer includes an n-clad layer, and the p-side layer includes a p-clad layer.

43. (New) A GaN type semiconductor light emitting device having a double hetero structure, the device comprising:
a substrate; and
compound semiconductor layers stacked on the substrate, the layers comprising:
at least one active layer;
at least one n-side layer including at least one hole-confining layer and at least one n-type contact layer; and
and at least one p-side layer including at least one electron-confining layer and at least one p-type contact layer,

Application No. 09/604,097
Attorney's Docket No. 033022-004
Page 7

wherein at least one band gap energy of the active layer is smaller than at least one band gap energy of each of the hole-confining layer and the electron confining layer, and the at least one band gap energy of the hole-confining layer is smaller than the at least one band gap energy of the electron-confining layer.

44. (New) The GaN based semiconductor light emitting device according to claim 43, wherein the active layer includes at least one InGaN layer and a thickness of the InGaN layer is not greater than 0.1 micrometers.

45. (New) The GaN based semiconductor light emitting device according to claim 43, wherein each of the n-side layer and the p-side layer includes at least one of Al and In.

46. (New) The GaN based semiconductor light emitting device according to claim 45, wherein the n-side layer includes In and the p-side layer includes Al and In.

47. (New) The GaN based semiconductor light emitting device according to claim 43, wherein a difference between the at least one band gap energy of the hole-confining layer and the at least one band gap energy of the active layer is not less than one third of a difference between the at least one band gap energy of the electron-confining layer and the at least one band gap energy of the active layer.

Application No. 09/604,097
Attorney's Docket No. 033022-004
Page 8

48. (New) The GaN based semiconductor light emitting device comprising:
means for injecting an electron into an active layer at low voltage;
means for injecting a hole into the active layer;
means for preventing leakage of the hole from the active layer; and
means for recombining the electron and hole to emit light.

49. (New) The GaN based semiconductor light emitting device according to claim 48, wherein the means for injecting an electron includes an n-type material having a first band gap energy, the means for injecting a hole includes a p-type material having a second band gap energy greater than first band gap energy, the means for preventing leakage includes the active layer having a third band gap energy less than the first band gap energy, the hole has a greater effective mass than that of the electron, and the light includes blue light.

50. (New) The GaN based semiconductor light emitting device according to claim 48, wherein the low voltage is lower than an operating voltage of a prior art semiconductor light emitting device having an n-clad layer of $\text{Al}_{0.15}\text{Ga}_{0.85}\text{N}$.

51. (New) A method for emitting light comprising:
injecting an electron into a gallium nitride type compound layer at a low voltage;
injecting a hole into the layer;
preventing leakage of the hole and the electron from an active layer; and
recombining the hole and the electron in the layer to emit light.

Application No. 09/604.097
Attorney's Docket No. 033022-004
Page 9

52. (New) The method according to claim 51, wherein injecting an electron includes applying a voltage to cause an electron to flow through an n-type material having a first band gap energy, injecting a hole includes applying a voltage to cause a hole to flow through a p-type material having a second band gap energy greater than the first band gap energy, preventing leakage includes confining the hole in the gallium nitride type compound layer having a third band gap energy less than the first band gap energy, an effective mass of the hole is greater than an effective mass of the electron, the light includes blue light, and the low voltage comprises an operating voltage lower than the voltage would if, for the same second band gap energy, the first and second band gap energies were equal.